

Claims

1. A reformat cooling system for reducing the temperature of a reformat to within a desired temperature range for use in a fuel processing subsystem, the fuel processing subsystem including a process water flow that supplies water to a fuel flow in the fuel processing subsystem; the reformat cooling system comprising:

at least one heat exchanger unit to transfer heat from the reformat flow to a portion of the process water flow, the at least one heat exchanger including a coolant inlet, a coolant outlet, a coolant flow path to direct the portion of the process water flow from the coolant inlet to the coolant outlet, a reformat inlet, a reformat outlet, and a reformat flow path to direct the reformat flow from the reformat inlet to the reformat outlet with a concurrent flow relationship between the portion of the process water flow in the coolant flow path and reformat flow in the reformat flow path, the heat exchanger having a sufficient effectiveness to fully vaporize the portion of the process water flow and bring the reformat flow and the portion of the process water flow toward a common exit temperature under normal operating conditions for the fuel processing subsystem;

a valve connected to the coolant inlet to control the flow rate of said portion of the process water flow to the coolant inlet;

a temperature sensor positioned to measure an outlet temperature of the reformat;

a controller connected to the temperature sensor and responsive thereto to selectively control the portion of the process water flow via the valve to regulate the common exit temperature to a desired temperature range.

2           2. The reformat cooling system of claim 1 wherein an auto-thermal reformer receives the portion of the process water flow from the coolant outlet and mixes the portion of the process water flow with the fuel flow.

2           3. The reformat cooling system of claim 1 wherein the temperature sensor is positioned at the reformat outlet.

2           4. The reformat cooling system of claim 1 wherein the temperature sensor is positioned at the coolant outlet.

2           5. The reformat cooling system of claim 1 wherein the controller is electronically coupled to the temperature sensor.

2           6. A method of operating a reformat cooling system for reducing the temperature of a reformat to within a desired temperature range for use in a fuel processing subsystem, the fuel processing subsystem including a process water flow that supplies water to a fuel flow in the fuel processing subsystem, the method comprising the steps of:

6               flowing a reformat through a first flow path;  
              flowing a portion of the process water through a second flow path with a  
8               concurrent flow relationship to the first flow path;  
              transferring heat from the reformat to the portion of the process water whereby  
10              the portion of the process water is fully vaporized and the reformat and the portion of  
              the process water approach a common exit temperature; and  
12              controlling the portion of the process water flow rate to regulate the temperature  
              of the reformat exiting the first flow path.

2 7. The method of claim 6 further comprising the step of adjusting the  
4 temperature range of the reformat exiting the first flow path in response to changes in  
catalytic activity in a hydrogen purification device receiving said reformat exiting the  
first flow path.

2 8. The method of claim 6 further comprising the step of recombining the portion  
of the process water flow with a remainder of the process water flow.

2 9. The method of claim 8 further comprising the step of transferring the  
recombined process water flow to an auto-thermal reformer.

2 10. A reformat cooling system for reducing the temperature of a reformat to  
within a desired temperature range for use in a fuel processing subsystem, the fuel  
processing subsystem including a process water flow that supplies water to a fuel flow  
4 in the fuel processing subsystem; the reformat cooling system comprising:

6 at least one heat exchanger unit to transfer heat from the reformat flow to a  
portion of the process water flow, the at least one heat exchanger including a coolant  
inlet, a coolant outlet, a coolant flow path to direct the portion of the process water flow  
8 from the coolant inlet to the coolant outlet, a reformat inlet, a reformat outlet, and a  
reformat flow path to direct the reformat flow from the reformat inlet to the  
10 reformat outlet with a concurrent flow relationship between the portion of the process  
water flow in the coolant flow path and reformat flow in the reformat flow path, the  
12 heat exchanger having a sufficient effectiveness to fully vaporize the portion of the  
process water flow and bring the reformat flow and the portion of the process water  
14 flow toward a common exit temperature under normal operating conditions for the fuel  
processing subsystem;

16            an active control loop to control the flow rate of the portion of the process water  
18            flow through the heat exchanger to maintain the common exit temperature within the  
             desired temperature range.

2            11. The reformat cooling system of claim 10 wherein the active control loop  
             is a feedback control loop.

2            12. The reformat cooling system of claim 11 wherein the active control loop  
             includes a valve to control the flow rate of the portion of the process water flow.

2            13. The reformat cooling system of claim 12 wherein the active control loop  
             monitors the reformat outlet temperature.

2            14. The reformat cooling system of claim 10 wherein the coolant outlet is  
             connected to an auto-thermal reformer.